

# SESRI Policy Brief

## Greywater for Qatar's Water & Food Security

### Popular Attitudes, Economic Estimates, and Policy Options

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Here we analyze how recycling greywater can slow the increase in costs that Qatar pays to subsidize seawater desalination and wastewater transport and treatment. Greywater is gently used water from showers, washing machines, swimming pools, AC units, and lavatory sinks. Greywater is distinct from more heavily polluted blackwater, which comes from toilets, kitchen sinks, and dishwashers. With little or no treatment, greywater can safely be used for several purposes, thereby replacing more expensive water resources such as desalinated or retreated water, and generating savings for the state. We provide quantitative information on the annual savings that can result from recycling greywater in Qatar, as well as the high acceptance of greywater use among Qatari citizens and white-collar expatriates.

#### Qatar's water challenge and untapped greywater resource

Due to low annual rainfall and depleted groundwater resources, Qatar relies on energy-hungry desalination and retreatment plants to meet growing water demand. With a high consumption rate of 551 liters/day/inhabitant,<sup>1</sup> the subsidized costs of desalinating, transporting, and retreating water represent an unnecessarily large state expenditure. The Tarsheed national awareness campaign and tariff increases by the Qatar General Electricity & Water Corporation (Kahramaa) and the Qatar Public Works Authority (Ashghal) are helping to temper the rise of these costs, but additional tools are required to counter growing demand. Recycling greywater can mitigate the growth of Qatar's water expenditure by slowing the increase in demand for desalinated seawater and retreated wastewater.

Currently, Qatar's water infrastructure does not take advantage of most of the country's greywater resource. Most plumbing systems in Qatar mix greywater and blackwater, thereby contaminating the entire mixture. As a result, all of the water in the network must go through costly tertiary-level treatment

before only a fraction of it is reused (24% according to government data).<sup>2</sup> Separating greywater from blackwater would reduce the amount of water going through treatment, thereby decreasing the overall cost of the treatment process, and allow the greywater to be reused elsewhere.

Studies from the Pacific Institute and the academic journal *Desalination* have found that it is safe to use lightly treated greywater for several purposes, including landscaping.<sup>3</sup> Currently, most irrigation for landscaping in Qatar uses desalinated water, so capturing and reusing greywater for landscaping would slow the increase in both the demand for desalinated water and the cost of desalination subsidies. Ashghal has successfully completed a small pilot greywater project at a mosque, in partnership with the Ministry of Awqaf and Islamic Affairs. Against a background of low oil prices and calls by Qatar's leadership for careful budget management, recycling greywater is an effective strategy for mitigating the increase of state expenditures.

In addition, results from previous SESRI public opinion surveys have indicated that both Qataris and expatriates oppose

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water subsidy withdrawals and support an increase in green spaces.<sup>4</sup> Recycling greywater could allow the state to simultaneously address both of these issues: by reusing greywater for landscaping, Qatar can increase the amount of green spaces for its residents without incurring prohibitively large costs for additional freshwater provision.

## Cost estimation

Recycling greywater in Qatar would not entail indiscriminately retrofitting all buildings in the country, or capturing all the greywater of any single building. These approaches are not economically sound. Greywater should be reused only where there is ample resource and minimal engineering costs are required, such as in large or new public buildings. Producing greywater, as a resource, costs the state and end-user almost nothing. If the greywater from a large public building is used for landscaping purposes nearby, there is virtually no processing cost either.

Using greywater for landscaping requires only the purchase of a sand filter, a few PVC pipelines, and chlorine, as well as simple bi-monthly maintenance taking approximately 5 to 15 minutes. Initial costs, including labor, would be between an estimated QAR 2500-7500 per building, depending on the building's architecture and the sand filter selected. Although basic bi-monthly maintenance would be required to clean the filter, this greywater system would obviate the existing need for manual hose irrigation and labor costs associated with a full-time gardener.

## Savings generated by recycling greywater

One of the most direct ways that recycling greywater can generate savings is by slowing the increase in demand for desalinated water. For example, greywater from ablutions can be reused for landscaping around mosques and replace the desalinated water that is currently used for this purpose. Cost estimates for desalination range from QAR 2.23/m<sup>3</sup> to

QAR 3.34/m<sup>3</sup>, and because Qatar cross-subsidizes water desalination, reductions in desalinated water consumption result in significant cost savings for the state.<sup>5</sup> According to Kahramaa, Qatar desalinated 535.4 million m<sup>3</sup> of water in 2015,<sup>6</sup> which translates to an annual cost ranging from QAR 1.2 billion to QAR 1.8 billion. In the same year, consumers generated about 129.3 million m<sup>3</sup> of greywater in Qatar.<sup>7</sup> Recycling 5% to 10% of this greywater resource and using it to replace desalinated water for landscaping, car washing, or toilet flushing would save between QAR 14.4 million and QAR 43.2 million per year in desalination costs, according to our estimates.

Recycling greywater also generates savings by reducing the growth of the amount of wastewater going through treatment. Wastewater treatment is currently financed by the government, though it is partly delegated to the private sector through contracts. Estimates for the direct cost of tertiary-level retreatment in Qatar range from QR 1.67/m<sup>3</sup> to QR 2.82/m<sup>3</sup>.<sup>8</sup> More importantly, the state also bears the substantial cost of transporting a portion of the sewage effluents to treatment plants. Thousands of large trucks transport the wastewater, and even when using minimal estimates for the truck drivers' salaries, the price of fuel, the cost to repair roads, and the price of the truck fleet's annual growth (to keep pace with demand), this process raises the cost of wastewater treatment to QAR 5.69/m<sup>3</sup>. In 2015, Qatar treated 194 million m<sup>3</sup> of wastewater,<sup>9</sup> meaning the cost for this process was approximately QAR 1.1 billion. Reusing 5% to 10% of Qatar's greywater could therefore lead to annual direct savings of at least QAR 36.8 million to QAR 73.6 million, in addition to the savings generated by slowing the increase in demand for desalinated water. Table 1 offers a more comprehensive summary of the cost-saving potential of reusing greywater, under different scenarios.

Table 1 shows estimates for the annual savings generated by recycling 5%, 10%,

i. Due to the variation of the international prices of natural gas, the actual cost (opportunity cost) of desalination varies more than this range suggests, but QEWC and other water producers benefit from a more stable, subsidized feedstock.

*Greywater is the only water resource in Qatar that is free and increasing*

TABLE 1

Savings generated under different scenarios of greywater reuse (in QAR/year)

	Baseline (minimal)	Intermediate 1 (conservative)	Intermediate 2 (ambitious)	High Savings (very ambitious)
<b>Potential Savings From Desalination, Per Year</b>				
Desalination cost (/m <sup>3</sup> )	2.23	2.65	3.05	3.34
Greywater recycled%	5%	10%	20%	30%
<b>Savings Potential/yr</b>	<b>14,420,667</b>	<b>34,273,333</b>	<b>78,893,333</b>	<b>129,592,000</b>
<b>Potential Savings from Wastewater Treatment, Per Year</b>				
Treatment Cost (/m <sup>3</sup> )	1.67	2.05	2.43	2.82
Greywater recycled%	5%	10%	20%	30%
<b>Savings Potential/yr</b>	<b>10,799,333</b>	<b>26,513,333</b>	<b>62,856,000</b>	<b>109,416,000</b>
<b>Wastewater Transportation Costs &amp; Potential Savings, Per Year</b>				
Truck purchases	133,560,000	253,207,500	415,520,000	415,520,000
Costs of Extra Road Maintenance	222,600,000	667,800,000	1,484,000,000	1,484,000,000
Fuel Costs	81,181,250	151,350,468	242,891,250	242,891,250
Driver Salary Cost	341,874,000	389,950,031	441,039,375	441,039,375
Total Transportation Cost	780,215,250	1,462,308,000	2,583,450,625	2,583,450,625
Greywater recycled%	5%	10%	20%	30%
<b>Transportation Savings Potential /yr</b>	<b>25,973,842</b>	<b>97,487,200</b>	<b>344,460,083</b>	<b>516,690,125</b>
<b>Total Savings/yr</b>	<b>51,193,842</b>	<b>158,273,867</b>	<b>486,209,417</b>	<b>755,698,125</b>

ii. This estimation of the main costs is conservative as it does not reflect a number of cost items, such as the private companies' profit margin for the transportation of sewage and treated sewage effluents.

20%, and 30% of Qatar’s greywater. These scenarios also include different values for the cost of seawater desalination, wastewater transport, and wastewater treatment, in order to reflect the minimum savings possible (in the “Baseline” scenario), and the maximum savings realistically possible (in the “High Savings” scenario). These different cost figures also reflect the various estimates for the cost of desalination and wastewater treatment. Capturing and reusing greywater from large mosques and public buildings to irrigate nearby green spaces is sufficient to recycle 5% to 10% of Qatar’s greywater. However, recycling 20% or 30% of this resource will require broader and more complex efforts.

### Acceptability of greywater use in Qatar: survey results

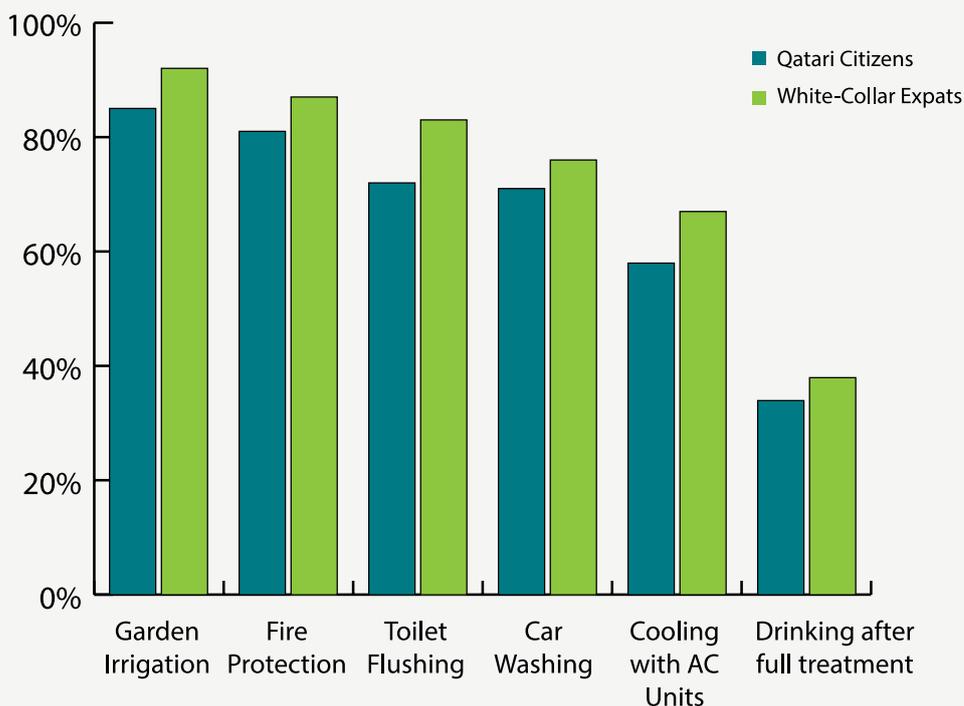
In order for a greywater reuse program to achieving these cost savings, citizens and residents of Qatar must be willing to use the resource. To that end, a national public opinion survey performed in May 2017 by the Social & Economic Survey Research Institute (SESRI) of Qatar University revealed that the vast majority of residents in Qatar are willing to use greywater. When asked if they would accept the use of

greywater instead of desalinated water for landscaping in their city, 82% of Qataris and 91% of white-collar expatriates said that they would. What’s more, a similarly large proportion of Qataris and white-collar expatriates said they would use greywater to irrigate their personal garden at home. While garden irrigation was the most widely accepted end-use, the survey also revealed that respondents are very willing to use greywater for a variety of other purposes, particularly fire protection and toilet flushing, as well as car washing to a lesser extent. Figure 1 shows the proportions of Qataris and white-collar expatriates that are willing to use greywater for six different purposes asked about in the survey.

### How to best introduce the importance of greywater in Qatar

The 2017 survey results also reveal that the manner in which the issue of greywater recycling is introduced to respondents has a significant impact on acceptability. The survey presented the question of greywater usage in three different ways. Version 1 framed greywater reuse in economic terms, as a way of reducing cost to the state. A second framing introduced greywater use

FIGURE 1  
Percentage of Qatari Citizens and White-Collar Expats Willing to Use Greywater for Various Purposes



*At least 80% of greywater is wasted and never reused*

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as a way of protecting the environment. Finally, a third framing presented greywater as a way to conserve water. Survey participants were asked, using one of the three framing devices, whether they would use greywater for each of the purposes illustrated in Figure 1. Figure 2 shows how these different framing techniques impacted respondents' acceptance of greywater use for landscaping.

For Qatari citizens, acceptance of greywater use for landscaping is not impacted by the framing of the question. As shown in Figure 2, none of the framing devices caused any statistically significant change in willingness to use greywater for landscaping (including the "water conservation" framing). What's more, the different framing techniques did not significantly impact Qatari citizens' willingness to use greywater for any of the six purposes included in the survey. However, the different framing techniques did have a significant impact on the willingness of white-collar expatriates to use greywater. Specifically, expatriates to whom the question of greywater use was posed as a cost saving or water conservation measure were more likely to be willing to use greywater for landscaping than expatriates who received the environmental protection formulation.

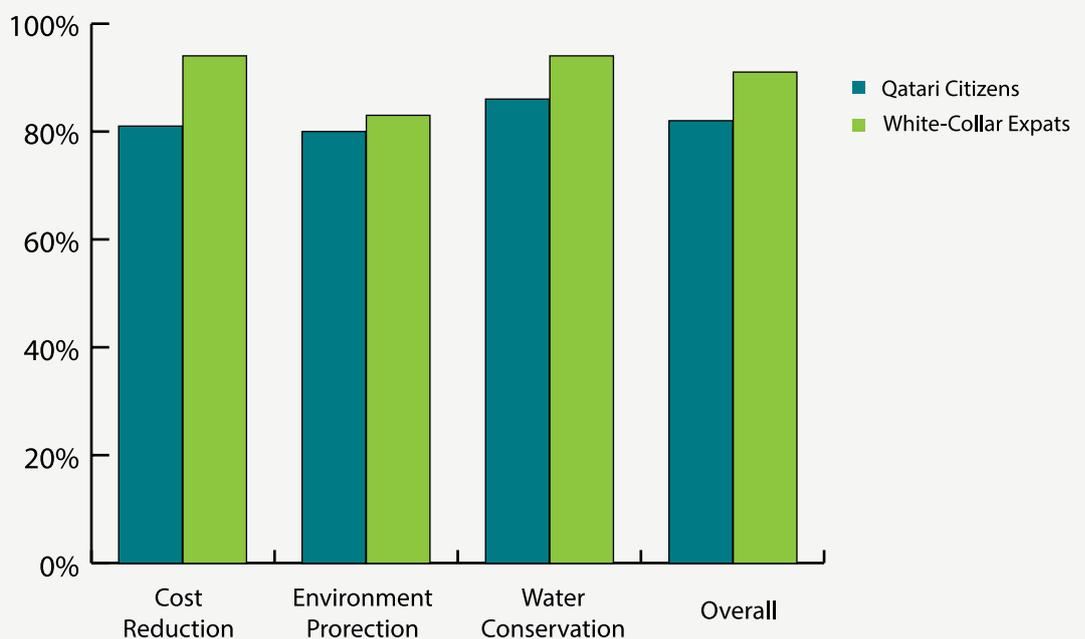
More significantly, this pattern of the cost saving and water conservation frameworks generating more willingness to use greywater among expatriates persists for five of the six uses included in the survey.

Among the respondents who said they would not be willing to use greywater for landscaping, health concerns were the most often-cited reason for not using the resource. This is not surprising, given most people's total unfamiliarity with the resource. However, as mentioned above, there is no evidence connecting greywater use in irrigation to public health problems.<sup>10</sup> Therefore, programs to encourage greywater reuse for landscaping should emphasize the safety of the resource, as well as the cost saving potential and the significant amount of water that will be conserved, rather than the environmental benefits.

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FIGURE 2  
Acceptance of Greywater Use for Landscaping, by Framing Treatment



82% of Qataris and 91% of expats say they would use greywater for landscaping

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## Policy Recommendations

### 1- Map greywater hotspots and use greywater for landscaping

Hotspots of greywater are places that consume large amounts of water and have the least contaminated greywater (e.g., mosques or hotel swimming pools). There, a small intervention can provide large quantities of water daily, at minimal cost. Currently, mosques and hotels use costly desalinated water for landscaping, but this practice could be decreased or completely stopped. Imams interviewed during this study enthusiastically supported the project, and large hotels also considered decreasing their environmental footprint and operating costs.

**2- Communicate with the population about greywater’s cost saving and conservation potential**, as it will generate even higher levels of willingness to use greywater, especially among white-collar expatriates.

**3- Implement additional pilot projects** and make mandatory the reuse of at least some of the greywater in all future mosques and hotels after 2019 or 2020. As the number of these two structures is set to increase very significantly ahead of the World Cup 2022, targeting these future sources of greywater can help Qatar become the regional leader in greywater reuse.

**4- Study potential for greywater use in artificial aquifer recharge, emergency risks mitigation, and irrigation.** Re-injecting water with low mineral content, such as greywater, can help increase the underground emergency reserves and stabilize the water table in quality and quantity, at a relatively low cost. However, the actual cost of this process will depend on the parameters of reinjection. For example, if reinjection is driven by gravity, costs will be very low. But if the reinjection process uses more advanced technologies, costs will be considerably higher. This would require additional research, including pilot projects.